Missouri Department of Natural Resources

Biological Assessment and Habitat Study Report

Muddy Creek
Grundy and Mercer Counties

September 2006 – March 2007

Prepared for:

Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

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1.0 Introduction

At the request of the Water Protection Program (**WPP**), the Environmental Services Program's (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted a biological and habitat assessment of Muddy Creek. Muddy Creek flows through a rural watershed in Grundy and Mercer counties in northern Missouri.

On the 2002 303(d) list, the entire 36.5-mile class-P section of Muddy Creek was listed as impaired for unknown pollutant(s) and unknown source(s) by the U. S. Environmental Protection Agency (**USEPA**). A total of nine Missouri streams are listed by USEPA for unknown pollutants and sources for a variety of reasons, but no specific reason is given for listing Muddy Creek. Habitat problems are not listed as a source of impairment, however, much of Muddy Creek has poor habitat due to poor riparian zones, steep and bare banks, and extensive channelization.

1.1 Purpose

The purpose of this study was to determine if the Muddy Creek macroinvertebrate community and/or stream habitat were impaired and, if so, determine the possible causes.

1.2 Objectives

- Determine if the macroinvertebrate community of Muddy Creek is impaired.
- Determine the habitat characteristics of Muddy Creek.
- Define the water quality characteristics of Muddy Creek.

1.3 Tasks

- Conduct a biological assessment of the macroinvertebrate community of Muddy Creek.
- Conduct a habitat assessment of Muddy Creek.
- Conduct a water quality assessment of Muddy Creek.

1.4 Null Hypotheses

- Macroinvertebrate assemblages are similar among Muddy Creek stream segments.
- Habitat quality is similar among Muddy Creek stream segments.
- Macroinvertebrate assemblages are similar between Muddy Creek and biocriteria reference streams.
- Habitat quality is similar between Muddy Creek and biocriteria reference streams.

2.0 Study Area

Muddy Creek originates just east of the town of Mercer. It flows south through its watershed of rural pasture and cropland (Table 2) until its confluence with the Thompson River just south of the town of Trenton.

According to Chapter 7 of the State of Missouri Water Quality Standards (10 CSR 20-7.031), the 36.5-mile segment from sec. 22, T. 66 N., R. 23 W. to its confluence with the Thompson River at sec. 16, T. 61 N., R. 24 W. is designated class "P". Beneficial use designations are for "livestock and wildlife watering and protection of warm water aquatic life and human health—fish consumption".

Muddy Creek and reference streams (**BIOREF**) East Fork Grand River and West Fork Big Creek sampled during this study are located within the Central Plains/Grand/Chariton Ecological Drainage Unit (**EDU**). An EDU is a region in which biological communities and habitat conditions are expected to be similar. See Appendix A for a map of EDUs and the 14-digit Hydrologic Units (**HU**) that contain the sampling reaches for Muddy Creek, East Fork Grand, and West Fork Big Creek. See Table 2 for a comparison of land use for the EDU and the 14-digit HUs.

2.1 Water Quality Concerns

The town of Trenton's municipal wastewater treatment facility (**WWTF**), along with other minor permitted facilities, contributes point source discharge to Muddy Creek. The discharge from the Trenton WWTP is approximately three miles from the mouth at the confluence with the Thompson River.

The impairment to Muddy Creek is listed as unknown though it is heavily channelized and has potential for non-point source (**NPS**) agricultural impact. Agricultural activity dominates the landscape in northern Missouri, including the Muddy Creek basin. This includes row crops and cattle pasture as well as confined animal feeding operations (**CAFO**). Erosion of agricultural land is a major cause of sediment contribution to northern Missouri streams. Oftentimes row crops are planted to the edge of stream banks, thus eliminating stabilizing riparian vegetation. This causes the banks to become unstable, steep, and without shade, resulting in higher summer water temperatures and loss of habitat. Channelization of larger northern Missouri streams, such as that on Muddy Creek, is cause for loss of channel structure and subsequent deterioration and loss of stream habitats.

2.2 Muddy Creek Site Descriptions

Five sampling locations were selected for this study. Because of high water throughout the spring sample season the most downstream station, station #1, was only sampled in the fall. Sample stations were located in Mercer and Grundy counties (see map in Appendix A). The sample stations are typical of the northern portion of the Central

Plains/Grand/Chariton EDU with steep banks, predominantly sand bottom with some fine silt, and little if any rock or gravel substrate. Much of the stream appears to be heavily channelized (see Table 4 and Figure 1). The average width and discharge measurements in cubic feet per second (**cfs**) during both survey periods are given for each Muddy Creek sampling station in Table 1.

Muddy Creek Station #1 (sec. 27/28, T. 61 N., R.24 W.) is located just downstream of the Trenton WWTP outfalls in Grundy County. Geographic coordinates at the upstream terminus of this station are Lat. 40.05061º, Long. -93.59431º. This station had more deep pools than the other stations with a predominantly sand and silt bottom. Because of deeper pools at this station, we were unable to sample it during the spring season and it was only sampled during the fall.

Muddy Creek Station #2 (N sec. 15/16, T. 61 N., R. 24 W.) is located just downstream of the 28th Street crossing along the north end of the east boundary of the Trenton Airport in Grundy County. Geographic coordinates at the upstream terminus of this station are Lat. 40.08980º, Long. -93.58980º. This site appeared to be heavily channelized with a very poor riparian corridor. The bottom was predominantly sand and very shallow.

Muddy Creek Station #3 (SW ¼ sec. 14, T. 62 N., R. 24 W.) is located just upstream of the Highway O crossing north of Trenton in Grundy County. Geographic coordinates at the downstream terminus of this station are Lat. 40.16299º, Long. -93.57624º. This site also was shallow with a predominantly sand bottom.

Muddy Creek Station #4 (NW ¼ sec. 24, T. 63 N., R. 24 W.) is located just upstream of Highway B near Spickard in Grundy County. Geographic coordinates at the downstream terminus of this station are Lat. 40.24677º, Long. -93.55265º. This site was mostly shallow with a predominantly sand bottom.

Muddy Creek Station #5 (NW ¼ sec. 24, T. 64 N., R. 24 W.) is located just downstream of the Imperial Street crossing just northeast of Mill Grove in Mercer County. Geographic coordinates at the upstream terminus of this station are Lat. 40.33493º, Long. -93.55260º. This site was less dominated by sand than the others. Large pieces of riprap stone were scattered approximately 200 yards downstream from the bridge creating an artificial coarse habitat. Part of the reach had shallow runs with a predominantly clay bottom. The lower end of the reach began to appear pooled likely due to a beaver dam farther downstream and was dominated by a soft silty bottom.

2.3 Biocriteria Reference Stations

East Fork Grand (N ½ sec. 32, T. 66 N., R. 30 W.) is located just downstream of the Highway 46 crossing east of Grant City in Worth County. Geographic coordinates at the upstream terminus are Lat. 40.48139º, Long. -94.31862º. This site had a predominantly sand bottom and was mostly wide and shallow with few deep pools.

West Fork Big (SW ¼ sec. 15, T. 65 N., R. 28 W.) is located just upstream of the 200th Street crossing just southwest of Eagleville in Harrison County. Geographic coordinates at the downstream terminus are Lat. 40.42594º, Long. -94.03860º. This site had a predominantly sand bottom at the lower end with more clay bottom as the reach proceeded upstream. There was a beaver pond at the upstream end of the reach. Because of deeper pools at this station, we were unable to sample it during the spring season and it was only sampled during the fall.

See Table 1 for average width and discharge measurements during both survey periods for the two BIOREF stations.

Table 1
Muddy Creek and Reference Streams Physical Characteristics of the Stations

Muddy Creek Station #	Ave. Width (feet)	Fall 2006 Flow (cfs)	Spring 2007 Flow (cfs)
1	36	1.82	-
2	32	1.4	36.1
3	47	0.7	27.9
4	31	0.73	27.4
5	36	0.35	17.4
East Fork Grand	48	7.58	104
West Fork Big	32	1.5	-

3.0 Methods

Sampling at Muddy Creek and BIOREF stations was conducted on September 19-26, 2006 and March 26-28, 2007. Sampling was conducted by Brian Nodine and Ken Lister of the ESP. Sampling consisted of macroinvertebrate collection and water quality sampling. Habitat assessments and quantitative channel measurements on Muddy Creek, East Fork Grand, and West Fork Big were conducted during the fall 2006 sampling season.

3.1 Habitat

Sedimentation is only one of several instream habitat problems associated with land use. Instream habitat can be directly measured yet the causes of habitat degradation can range from local to watershed scale sources. For this study, habitat measurements were collected at the watershed, reach, and local scales to facilitate assessment of the causes of poor habitat conditions.

3.1.1 Land Use

Land cover data were derived from the Thematic Mapper satellite data from 2001-2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**). See Section 2.0 and Table 2 for land use information.

3.1.2 Habitat Assessment

A standardized habitat procedure for Glide/Pool stream types was followed in the Stream Habitat Assessment Project Procedure (**SHAPP**) (MDNR 2003b).

3.1.3 Sinuosity

Sinuosity was used as a rough indicator of the amount of channelization that has occurred. Sinuosity was measured using the National Hydrography Dataset (**NHD**) and is represented as a ratio of the actual stream segment length compared to the straight-line distance between two points. Measurement points were approximately two miles apart with the sampling reach at the center.

3.1.4 Instream Width and Depth Measurements

It is typical for streams in northern Missouri to suffer from a lack of instream habitat due to poor land use and channelization. These streams trend toward wider channels with shallower water depths and more homogeneous habitat (Haithcoat et al. 2003c). At each sampling station a series of ten bank to bank transects were established. Each transect was equally spaced within the sampling reach. The sampling reach was 20x the average width. Measurements taken at each transect included lower bank width (see SHAPP for a definition of lower bank), wetted width, and water depth at ¼, ½, and ¾ of the distance across the wetted width. To document critical habitat conditions, measurements were collected during the fall low flow period.

3.2 Physicochemical Data Collection and Analysis

During each survey period, *in situ* water quality measurements were collected at all stations for temperature (°C), dissolved oxygen concentration (mg/L), conductivity (µS/cm), and pH. These measurements followed Standard Operating Procedures MDNR-FSS-101 Field Measurement of Water Temperature (MDNR 1993), MDNR-WQMS-103 Sample Collection and Field Analysis for Dissolved Oxygen Using a Membrane Electrode Meter (MDNR 2002b), MDNR-FSS-102 Field Analysis for Specific Conductance (MDNR 2000a), and MDNR-FSS-100 Field Analysis of Water Samples for pH (MDNR 2001a) respectively. Additionally, water samples were collected and returned for analyses by ESP's Chemical Analysis Section for chloride, total phosphorus, ammonia-N, nitrate + nitrite-N, and total nitrogen. Turbidity (NTU) was analyzed by the WQMS.

Stream discharge in cubic feet per second (**cfs**) was measured at each sampling station using a Marsh-McBirney Flo-Mate Model 2000. Discharge was calculated per the methods in the Standard Operating Procedure MDNR-FSS-113 Flow Measurement in Open Channels (MDNR 2001b).

Physicochemical data were summarized and presented in tabular form for comparison among the five Muddy Creek stations, between the Muddy Creek stations and the BIOREF stations, and between sample seasons.

3.3 Macroinvertebrate Collection and Analysis

A standardized sample collection procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**) (MDNR 2003a). Three standard habitats, non-flowing water with depositional substrate (**NF**), large woody debris (**SG**), and rootmat (**RM**) at the stream edge, were sampled at all locations.

A standardized sample analysis procedure was followed as described in the SMSBPP. The SMSBPP provides details on the calculation of metrics and scoring of the multi-metric Macroinvertebrate Stream Condition Index (**MSCI**). The following four metrics were used: 1) Taxa Richness (**TR**); 2) total number of taxa in the orders Ephemeroptera, Plecoptera, and Trichoptera (**EPTT**); 3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**).

Macroinvertebrate data were analyzed in three specific ways. First, Muddy Creek stations were compared to biological criteria for the Central Plains/Grand/Chariton EDU as well as compared with concurrent BIOREF station data. Second, a longitudinal comparison between the five Muddy Creek sites was performed (four sites in the spring). Finally, a comparison was made of Muddy Creek data between fall and spring sampling seasons. See Tables 10 and 11 for biological criteria for warm water reference streams in the Central Plains/Grand/Chariton EDU for the fall and spring.

4.0 Quality Assurance/Quality Control (QA/QC)

QA/QC procedures were followed as described in pertinent Standard Operating and Project Procedures.

5.0 Data Results and Analyses

5.1 Land Use

According to MoRAP land cover files (see Table 2) the watershed land use of Muddy Creek is comprised mostly of grassland followed by cropland with some forest. A very small area of the land in the Muddy Creek drainage is urban, wetland, or open water. The

majority of land use of the two reference watersheds is grassland followed by nearly equal amounts of cropland and forest.

Table 2
Percent Land Cover

	14-digit HUC	Urban	Cropland	Grassland	Forest	Wetland	Open Water
Central Plains/Grand/Chariton Drainages EDU		2	28	45	18	-	-
Muddy Creek							
Sites 1-3	10280102170003	8	32	43	11	3	1
Sites 4-5	10280102170002	2	19	51	23	2	0
Reference Streams							
East Fork Grand	10280101060008	0	22	53	19	2	1
West Fork Big	10280101150003	1	23	49	21	2	1

5.2 Habitat Assessment

Habitat assessment scores were recorded for each sampling station. Results are presented in Table 3. According to project procedure guidance, the total score from the physical habitat assessment of the study site should be at least 75% of the total score of the habitat assessment(s) of the BIOREF station(s) to support a similar biological community. Habitat scores for three of the five Muddy Creek stations failed to meet the 75% requirement. It is therefore inferred that, based on habitat scores, the two sites attaining at least 75% of the BIOREF stations should support comparable biological communities. The three that failed however, cannot be assumed to have adequate habitat to sustain similar biological communities.

Table 3
Habitat Scores (Fall 2006)

BIOREF Streams	Habitat Score	**Muddy Creek** Station #	Habitat Score	% of WFB/EFG BIOREFs
West Fork Big	112	1	93	83/78
East Fork Grand	120	2	69*	62/58
		3	95	85/79
		4	82*	73/68
		5	56*	50/47

* <75% of BIOREF scores

5.3 Sinuosity and Riparian Zone Condition

Characteristics for each sampling station are listed in Table 4. Sinuosity was calculated for each station by choosing points on the river approximately two miles apart, with the sampling station in the approximate center of the reach. Sinuosity ratios are calculated by comparing the stream distance between two points to the direct spatial distance

between the same two points. The higher the sinuosity ratio, the less likely the stream segment is channelized. The sinuosity was 1.73 at East Fork Grand and 1.48 at West Fork Big, indicating a lack of channelization. At the Muddy Creek stations sinuosity only ranged from 1.00 to 1.05, indicating a high degree of channelization, which is also visually apparent on maps of the stream.

Riparian zone conditions derived from SHAPPs conducted in the fall at Muddy Creek ranged from mixed to very poor. Riparian zone conditions at the two BIOREF stations were mixed. At the West Fork station, one bank was very good while the other was very poor.

Table 4
Sinuosity and Riparian Zone Condition

Station	Sinuosity	Likely to be channelized	Riparian Zone Condition
Muddy Creek			
1	1.02	Yes	Mixed
2	1.00	Yes	Very poor
3	1.05	Yes	Mixed
4	1.04	Yes	Poor
5	1.05	Yes	Very poor
West Fork Big	1.73	No	Mixed*
East Fork Grand	1.48	No	Mixed

*Left descending bank very good, right descending bank very poor

5.4 Stream Width and Depth Measurements

Transect measurements for average channel width (= lower bank width), average wetted width, average stream depth, maximum depth, and standard deviation for depths of Muddy Creek stations are represented in Table 5. Overall average values and ranges from selected BIOREF stations are also presented. Thus the BIOREF data represent an average of eight stream channel measurements all from the Central Plains/Grand/Chariton EDU, including the East Fork Grand and West Fork Big. Channel width to wetted width and wetted width to depth ratios are also presented. The ratios allow for standardization of channel measurements for longitudinal comparisons. Channel width typically widens as a stream proceeds downstream, but wetted width and depth do not necessarily have the same pattern. These ratios allow channel widths and depths to be compared along a stream reach.

The average channel width of Muddy Creek did not show the tendency to increase upon moving downstream from stations 2 through 5. These trends are likely due to the apparent channelization (see Figure 1).

With the exception of Muddy Creek station #1, maximum depths for the BIOREF stations were greater than the maximum depths for Muddy Creek (see Figure 2). The

abrupt increase in depth at Muddy Creek station #1 is possibly due to the fact it is immediately downstream of the Trenton WWTP outfalls and near the confluence with the Thompson River.

Figure 1
Muddy Creek Channel Widths

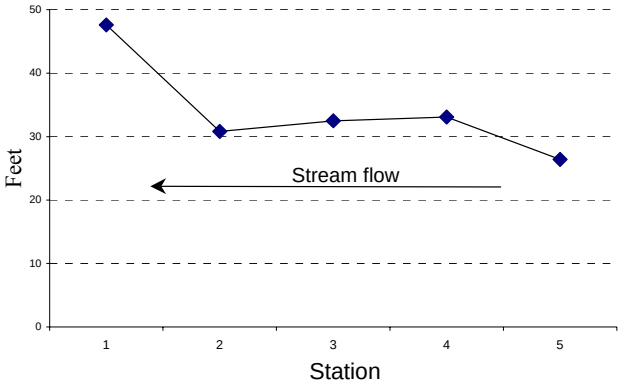


Figure 2
Maximum Depths

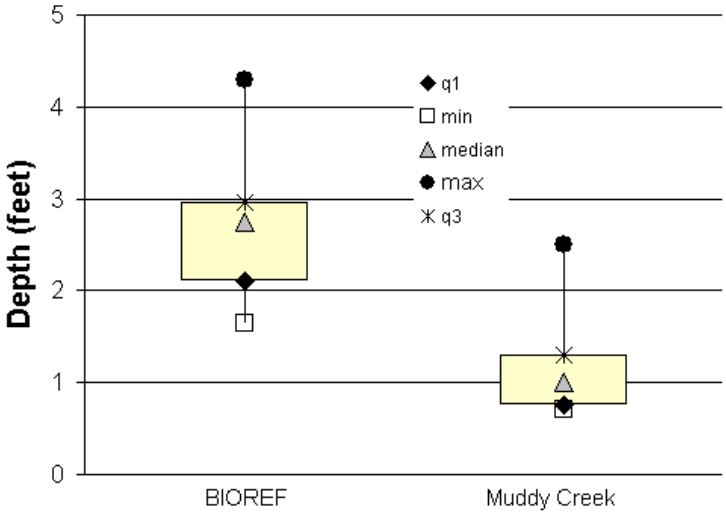


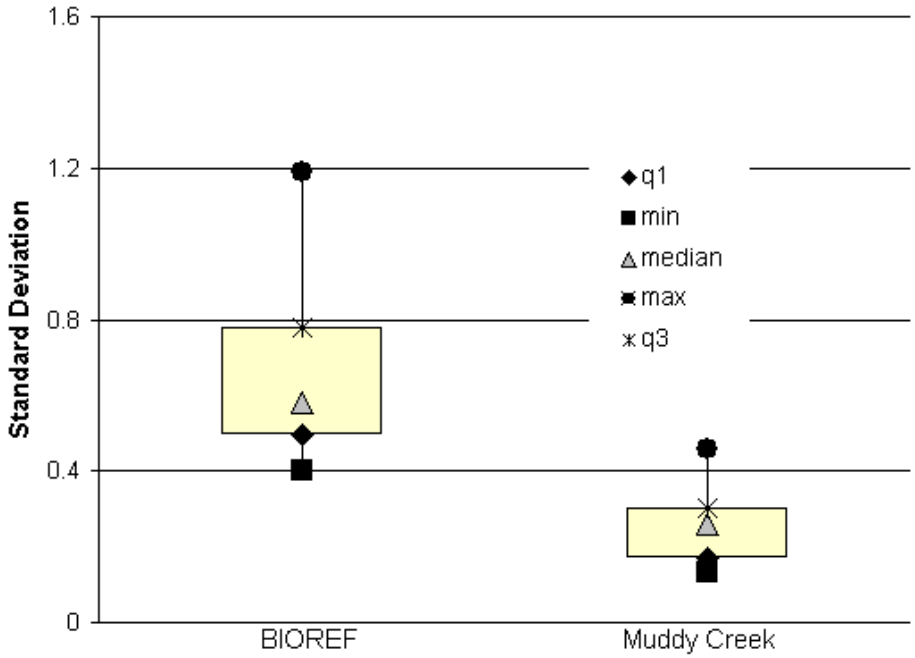
Table 5
Channel Dimensions

Station	Average Channel Width (ft.)	Average Wetted Width (ft.)	Average Depth (ft.)	Maximum Depth (ft.)	Standard Deviation of Depth	Channel Width/Wetted Width	Wetted Width/Depth
Muddy Creek							
1	47.6	47.6	1.18	2.50	0.46	1.00	40.34
2	30.8	17.3	0.25	0.70	0.13	1.78	68.29
3	32.5	19.8	0.42	1.00	0.26	1.64	47.52
4	33.1	18.5	0.26	0.75	0.17	1.79	70.70
5	26.4	24.9	0.35	1.30	0.30	1.06	70.47
BIOREF*							
average	42.7	26.9	0.9	2.7	0.67	1.60	32.50
range	32.8-57.0	19.6-40.3	0.7-1.11	1.6-4.3	0.40-1.19	1.37-1.88	17.60-57.96

* All BIOREF Central Plains/Grand/Chariton EDU stations including the two sampled streams for this study, West Fork Big and East Fork Grand as well as Spring Creek, Locust Creek, West Locust Creek, No Creek, Marrowbone Creek, and Grindstone Creek.

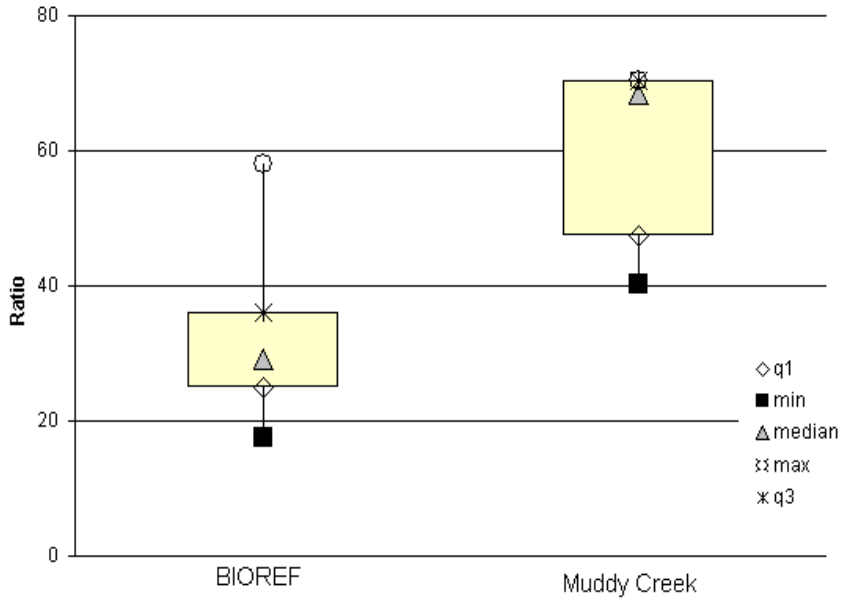
Standard deviations of depths for the BIOREF stations were higher than those of the Muddy Creek stations, indicating less heterogeneity of depths on Muddy Creek (see Figure 3).

Figure 3
Standard Deviation of Average Depths



The ratio of average channel width to average wetted width for the BIOREF stations was not noticeably different from the ratios for the Muddy Creek stations. However, the ratio of average wetted width to depth was considerably lower in the BIOREF stations than the range for the Muddy Creek stations. The higher wetted width to depth ratio indicates a tendency toward a wider and shallower stream (see Figure 4).

Figure 4
Average Wetted Width/Depth Ratios



5.5 Physicochemical Data

In situ water quality measurements and turbidity are summarized in Table 6 (fall 2006) and Table 7 (spring 2007). Mean temperatures at Muddy Creek stations were 16.5°C and 17.5°C in the fall 2006 and spring 2007 surveys, respectively.

Conductivity levels were consistent among stations and between seasons with the exception of Muddy Creek station #1 where the conductivity was notably higher. This is likely due to this stations location directly below the Trenton WWTP outfalls. Dissolved oxygen levels were consistent between stations and seasons and did not fall below the Water Quality Standards minimum concentration for warm-water and cool-water fisheries (5.0 mg/L) at three stations. Typically, dissolved oxygen levels are higher during the spring season when water temperatures are cooler, however, water temperatures were somewhat consistent between seasons for this study.

Turbidity levels during the fall were consistent. During the spring, turbidity values were higher than they were during the fall because of high levels of runoff during sampling.

Table 6
In situ Water Quality Measurements and Turbidity at all Stations (Fall 2006)

Station	Parameter				
	Temp. (ºC)	Diss. O_2 (mg/L)	Cond. (µmhos/cm)	pH	Turb. (NTU)
Muddy Creek					
1	13.5	7.6	1040	7.8	3.9
2	18.0	8.5	452	8.0	2.2
3	15.0	10.0	446	8.0	3.7
4	18.0	9.6	478	8.1	2.0
5	18.0	11.4	505	8.1	5.0
BIOREF					
West Fork Big	16.5	7.1	334	8.0	18.1
East Fork Grand	15.5	7.9	371	8.1	6.6

Table 7
In situ Water Quality Measurements and Turbidity at all Stations (Spring 2007)

Station	Parameter				
	Temp. (ºC)	Diss. O_2 (mg/L)	Cond. (µmhos/cm)	pH	Turb. (NTU)
Muddy Creek					
1	-	-	-	-	-
2	19.0	7.1	405	7.9	61.7
3	16.0	8.4	436	7.8	41.7
4	20.0	7.2	426	7.9	20.6
5	15.0	8.0	457	8.0	13.4
BIOREF					
West Fork Big	-	-	-	-	-
East Fork Grand	16	7.3	365	7.9	77.8

Nutrient and chloride concentrations are presented in Table 8 (fall 2006) and Table 9 (spring 2007). All ammonia results were below detectable limits during both survey periods. Nitrate + nitrite, total nitrogen, and total phosphorus concentrations were generally higher during the spring season and notably higher at Muddy Creek station #1 downstream from the Trenton WWTP. Chloride levels were consistent between stations and seasons with the exception of Muddy Creek station #1, once again the WWTP being the likely source. All chloride levels were below chronic criteria for protection of aquatic life and drinking water supply.

Table 8
Nutrient Concentrations at all Stations (Fall 2006)

Station	Sample #	Parameter (mg/L)				
		NH_3-N	$NO_3 + NO_2$-N	Total N	Total Phos.	Chloride
Muddy Creek						
1	0607285	<0.03	0.01	0.99	0.56	195
2	0607284	<0.03	0.01	0.29	0.06	12.2
3	0607286	<0.03	0.01	0.31	0.04	11.3
4	0607287	<0.03	<0.01	0.29	0.03	14.3
5	0607288	<0.03	<0.01	0.36	0.03	18.3
BIOREF						
West Fork Big	0607291	<0.03	0.09	0.78	0.11	11.2
East Fork Grand	0607290	<0.03	<0.01	0.57	0.10	12.0

Table 9
Nutrient Concentrations at all Stations (Spring 2007)

Station	Sample #	Parameter (mg/L)				
		NH_3-N	$NO_3 + NO_2$-N	Total N	Total Phos.	Chloride
Muddy Creek						
1	-	-	-	-	-	-
2	0704032	<0.03	0.29	0.86	0.17	13.7
3	0704034	<0.03	0.21	0.70	0.14	13.7
4	0704033	<0.03	0.26	0.76	0.11	13.8
5	0704035	<0.03	0.17	0.65	0.08	14.4
BIOREF						
West Fork Big	-	-	-	-	-	-
East Fork Grand	0704027	<0.03	1.0	2.04	0.27	12.5

5.6 Biological Assessment

5.6.1 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)

The SMSBPP evaluation used biological criteria that were calculated from ESP's database of Wadeable/Perennial Biological Reference Streams for the Central Plains/Grand/Chariton EDU. See Biological Criteria for Wadeable/Perennial Streams of Missouri (MDNR 2002a) for more explanation. These criteria are listed for fall and spring seasons in Tables 10 and 11, respectively. Macroinvertebrate Stream Condition Index sustainability scores of 20-16 qualify as fully sustaining, 14-10 as partially sustaining, and 8-4 as non-sustaining of aquatic life.

Table 10
Biological Criteria for Warm Water Reference Streams in the Central Plains/Grand/Chariton EDU (Fall Season)

	Score = 5	Score = 3	Score = 1
TR	>52	26-52	<26
EPTT	>9	4-9	<4
BI	<7.18	7.18-8.59	>8.59
SDI	>2.69	1.34-2.69	<1.34

Table 11
Biological Criteria for Warm Water Reference Streams in the Central Plains/Grand/Chariton EDU (Spring Season)

	Score = 5	Score = 3	Score =1
TR	>51	26-51	<26
EPTT	>8	8-4	<4
BI	<7.24	7.24-8.62	>8.62
SDI	>2.53	1.26-2.53	<1.26

5.6.2 Comparisons with Regional Reference Streams in the Central Plains/Grand/Chariton EDU

Macroinvertebrate Stream Condition Indices were calculated for Muddy Creek and two BIOREF stations as derived from biological criteria from Central Plains/Grand/Chariton EDU reference streams. The four metrics, total scores, and MSCI sustainability rankings during fall 2006 and spring 2007 are presented in Tables 12 and 13, respectively. A taxa list for all stations is attached as Appendix B.

Table 12
Metric Values and Stream Condition Indices, Fall 2006 Sampling Season

Station	Sample #	TR	EPTT	BI	SDI	MSCI	Sustainability
Muddy Creek							
1	0602737	65	13	7.95	2.79	18	**FULL**
2	0602736	55	15	6.76	2.46	18	**FULL**
3	0602738	60	10	6.77	2.80	20	**FULL**
4	0602739	66	10	6.55	2.91	20	**FULL**
5	0602740	69	16	7.04	3.08	20	**FULL**
BIOREF							
West Fork Big	0602743	73	17	6.99	3.09	20	**FULL**
East Fork Grand	0602742	72	24	6.26	3.45	20	**FULL**

Table 13
Metric Values and Stream Condition Indices, Spring 2007 Sampling Season

Station	Sample #	TR	EPTT	BI	SDI	MSCI	Sustainability
Muddy Creek							
1	-	-	-	-	-	-	-
2	0703232	50	9	7.27	2.69	16	**FULL**
3	0703234	44	9	7.38	2.32	14	**PARTIAL**
4	0703233	54	7	6.99	3.00	18	**FULL**
5	0703235	63	10	7.39	3.20	18	**FULL**
BIOREF							
West Fork Big	-	-	-	-	-	-	-
East Fork Grand	0703227	61	11	6.54	3.03	20	**FULL**

5.6.3 Muddy Creek Longitudinal Comparison

There are no significant differences between MSCI scores and metrics longitudinally for the fall sampling season when all stations received a "full" sustainability ranking. There was one difference during the spring sampling season when station #3 received only a "partial" sustainability ranking with an MSCI score of 14.

5.6.4 Muddy Creek Seasonal Comparison

With the exception of station #3 during the spring sampling season, there were no differences in sustainability rankings between seasons. During the fall, overall MSCI values trended somewhat higher than those from the spring season.

5.6.5 Comparison of Muddy Creek with BIOREF Stations

The only difference between sustainability rankings between the Muddy Creek and two BIOREF stations was the station #3 spring sample (see Section 5.6.3).

5.6.6 Macroinvertebrate Percent and Community Composition

Macroinvertebrate taxa richness, EPT taxa, percent EPT relative abundance, and top five dominant families are presented in Table 14 for the fall sampling season and Table 15 for the spring sampling season. The percent of relative abundance data were averaged from the sum of the three macroinvertebrate habitats (depositional non-flow, woody debris, and rootmat) sampled at each station.

Diptera was the dominant order at all five Muddy Creek stations during the fall sampling season, particularly at station #1 just below the Trenton WWTP. During the spring sample season, Ephemeroptera was the dominant order at stations 2, 3, and 4. This is apparently the result of Caenidae as the dominant family at those stations. The Diptera

family Chironomidae was dominant at all Muddy Creek stations during the fall sampling season and at station #5 during the spring sampling season. Chironomidae was also the dominant family at both BIOREF stations during the fall and at East Fork Grand BIOREF station during the spring.

Table 14
Fall 2006 Macroinvertebrate Composition (percentages rounded to whole numbers)

	Muddy Creek					WFB	EFG
Station	1	2	3	4	5		
Taxa Richness	65	55	60	66	69	73	72
EPTT	13	15	10	10	16	17	24
% Ephemeroptera	8	47	40	44	32	28	39
% Plecoptera	0	0	0	0	0	0	0
% Trichoptera	7	6	3	4	6	2	11
Total EPT %	15	53	43	48	38	30	50
% Diptera	73	40	44	40	33	51	42
% Top Five Dominant Families							
Chironomidae	70	40	44	37	32	50	41
Tubificidae	10						
Caenidae	4	34	31	29	25	22	15
Baetidae	2	3		5			6
Ceratopogonidae	2						
Leptoceridae		6	3	4	5		6
Leptohyphidae		4					
Leptophlebiidae			5	6			
Coenagrionidae			4			2	
Hyalellidae					10	3	
Sphaeriidae					7		
Elmidae						8	
Heptageniidae							6

Table 15
Spring 2007 Macroinvertebrate Composition (percentages rounded to whole numbers)

	Muddy Creek					WFB	EFG
Station	1	2	3	4	5		
Taxa Richness	-	50	44	54	63	-	61
EPTT	-	9	9	7	10	-	11
% Ephemeroptera	-	46	55	41	11	-	39
% Plecoptera	-	1	0	2	1	-	2
% Trichoptera	-	3	3	2	1	-	1
Total EPT %	-	50	58	45	13	-	42
% Diptera	-	34	31	36	49	-	44
% Top Five Dominant Families							
Caenidae	-	37	50	32	8	-	19
Chironomidae	-	31	28	31	44	-	33
Leptophlebiidae	-	6		4		-	6
Enchytraeidae	-	5	2	4	3	-	
Tubificidae	-	4			3	-	
Leptoceridae	-		3			-	
Hyalellidae	-		2	3	21	-	
Heptageniidae	-					-	10
Simuliidae	-					-	7

6.0 Discussion

Physicochemical results revealed few definitive trends other than typical seasonal differences.

Other than station #3 in the spring sampling season, macroinvertebrate data did not reveal any notable impairment in Muddy Creek and otherwise tend to indicate a healthy community for its EDU. A possible cause of the failure of station #3 to reach the fully sustainable status and the generally lower MSCI values during the spring sampling season could be the high scouring flows present during that season.

In general, the biological assessment fails to indicate impairment in spite of three of the five Muddy Creek stations with SHAPP scores that are below the acceptable 75% threshold. Further habitat degradation can be seen in the evidence of historic channelization through the extent of the study area (see Table 4 and Figure 1). At some of the stations, good depositional non-flow habitat and woody debris were limited, which is typical of channelized streams.

Channel dimension measurements provide further evidence of habitat impairment; especially the wetted width/depth ratios showing wide and shallow flow (see Figure 4).

Maximum depths in the BIOREF stations were higher than those in Muddy Creek (see Figure 2) and greater standard deviations for depths in the BIOREF stations (see Figure 3) indicate lower depth heterogeneity in Muddy Creek.

Although the macroinvertebrate evaluation shows full sustainability during both seasons, with the exception of one of nine samples in Muddy Creek, this may not necessarily give the full assessment of the overall quality of the stream. Macroinvertebrate assessments tend to be more suitable for water and substrate quality studies; however, it is recommended that streams that are extensively channelized and are lacking in deeper water also be evaluated for fish communities (MDNR 2005).

7.0 Conclusions

Based on this study, there can be no conclusion drawn that Muddy Creek is biologically impaired by sediment. There are, however, based on habitat assessment and stream dimension measurements, significant physical alterations to the stream.

8.0 Recommendations

Since habitat appears to be an issue due to channelization, Muddy Creek should continue to be monitored and should include a fish community assessment.

9.0 Summary

- The null hypothesis that macroinvertebrate assemblages are similar between Muddy Creek segments, except station #3 during the spring season, is accepted.
- Because of historic channelization and poor channel quality dimensions, the null hypothesis is accepted that habitat quality among Muddy Creek segments is similar.
- The null hypothesis that macroinvertebrate assemblages are similar between Muddy Creek and BIOREF streams is accepted.
- The null hypothesis that habitat quality is similar between Muddy Creek and suitable BIOREF streams is rejected.

10.0 Literature Cited

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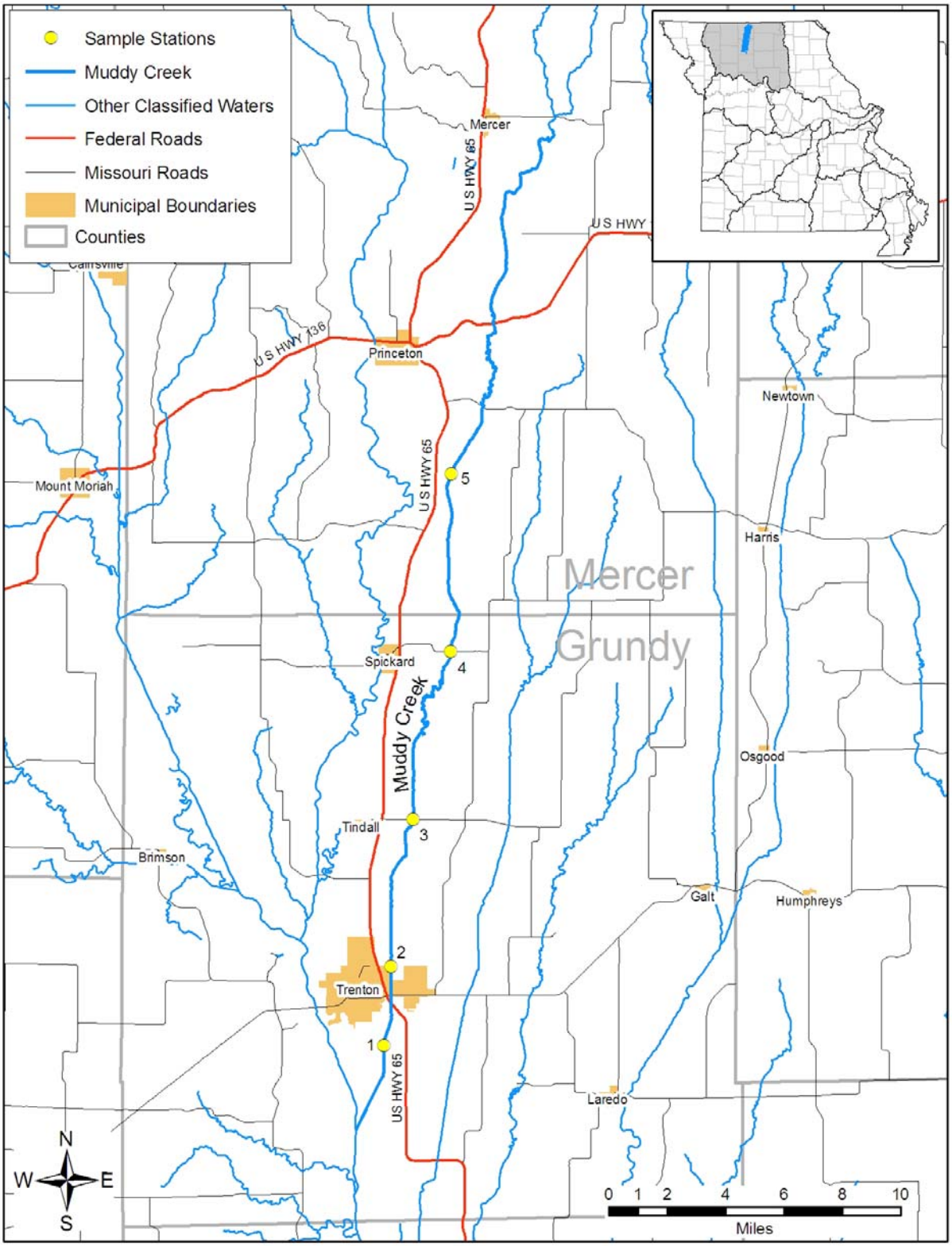
Appendix A

Map
Muddy Creek
Plains/Grand/Chariton Ecological Drainage Unit (EDU)


Sample Stations
Muddy Creek
Other Classified Waters
Federal Roads
Missouri Roads
Municipal Boundaries
Counties
Mercer
U S HWY 65
U S HWY
U S HWY 136
Princeton
Newtown
Mount Moriah
U S HWY 65
5
Harris
Mercer
Grundy
Spickard
4
Muddy Creek
Osgood
Tindall
3
Brimson
Galt
Humphreys
2
Trenton
1
US HWY 65
Laredo
N
W
E
S
0 1 2 4 6 8 10
Miles

Appendix B

Macroinvertebrate Bench Sheets

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602737], Station #1, Sample Date: 9/20/2006 9:10:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina		1	
AMPHIPODA			
Crangonyx		16	
COLEOPTERA			
Berosus		-99	
Dubiraphia	1		
Helichus lithophilus			1
Peltodytes	3		
Tropisternus		-99	
DIPTERA			
Ablabesmyia		1	2
Ceratopogoninae	14	2	
Chironomus	47	2	1
Cladotanytarsus	32		1
Cricotopus bicinctus		1	
Cryptochironomus	8		
Cryptotendipes	5		
Dicrotendipes	12	13	29
Forcipomyiinae	1		3
Glyptotendipes	2	125	133
Goeldichironomus	2	8	1
Labrundinia			3
Micropsectra			1
Parachironomus		3	
Paracladopelma	2		
Paratendipes	12		
Polypedilum halterale grp	15		
Polypedilum illinoense grp	3	6	3
Polypedilum scalaenum grp	1		
Procladius	2		
Psychoda	1		
Saetheria	1		
Stempellinella	7		
Stictochironomus	4		
Tanytarsus	36	67	89
Thienemannimyia grp.		2	4
undescribed Empididae		1	
EPHEMEROPTERA			
Baetisca lacustris	1		

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602737], Station #1, Sample Date: 9/20/2006 9:10:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Brachycercus	1		
Caenis hilaris			6
Caenis latipennis	19	4	6
Callibaetis		7	
Hexagenia limbata	9	1	
Leptophlebiidae	1	1	
Paracloeodes	1	1	2
Procloeon	7		3
Stenacron		1	
Tricorythodes	1	3	
HEMIPTERA			
Corixidae	4		
LIMNOPHILA			
Lymnaeidae	1		
Physella	3	8	3
Planorbella			1
ODONATA			
Argia	1	7	2
Enallagma		6	
Gomphus	4		
Ischnura		1	
Libellula		-99	
Progomphus obscurus	-99		
RHYNCHOBDELLIDA			
Glossiphoniidae		1	
TRICHOPTERA			
Nectopsyche		5	1
Oecetis		1	
TRICLADIDA			
Planariidae		11	
TUBIFICIDA			
Aulodrilus	4		
Ilyodrilus templetoni	5	3	
Limnodrilus cervix	1		
Limnodrilus hoffmeisteri	5		
Tubificidae	49	30	
VENEROIDEA			
Sphaeriidae	8	2	

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602736], Station #2, Sample Date: 9/19/2006 3:20:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca		1	
COLEOPTERA			
Dubiraphia	1	1	1
Helichus lithophilus		1	4
Macronychus glabratus			4
Neoporus	1	6	1
Scirtidae			1
Tropisternus		1	
DIPTERA			
Ablabesmyia	1	2	1
Ceratopogoninae	1		
Chironomus	2		
Cladotanytarsus	4		6
Corynoneura	2		
Cricotopus bicinctus	5		
Cricotopus/Orthocladius		1	2
Cryptotendipes	1		
Dicrotendipes	4	10	49
Forcipomyiinae			1
Glyptotendipes	1	1	2
Labrundinia	2	9	1
Nanocladius		6	2
Parachironomus		3	1
Parakiefferiella			1
Phaenopsectra	1		
Polypedilum convictum			1
Polypedilum illinoense grp	3	9	2
Stempellinella	8		
Stenochironomus			1
Tanytarsus	55	34	111
Thienemanniella			1
Thienemannimyia grp.		6	2
EPHEMEROPTERA			
Brachycercus		1	
Caenis hilaris	1	4	
Caenis latipennis	143	119	40
Callibaetis	1	3	
Fallceon			3
Heptageniidae	1	1	10

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602736], Station #2, Sample Date: 9/19/2006 3:20:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Hexagenia limbata	10		
Leptophlebiidae	8	12	4
Paracloeodes	4	1	13
Procloeon	4		
Stenonema femoratum	1		
Tricorythodes		31	7
LIMNOPHILA			
Lymnaeidae		2	
Physella		9	
ODONATA			
Argia	3	11	
Gomphus	1		
Hetaerina		8	
Macromia		-99	
Progomphus obscurus	-99		
TRICHOPTERA			
Cheumatopsyche		1	
Cyrnellus fraternus			1
Nectopsyche	4	44	2
TUBIFICIDA			
Enchytraeidae		1	
Tubificidae	1		1
VENEROIDEA			
Sphaeriidae	3	1	

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602738], Station #3, Sample Date: 9/20/2006 11:50:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina		1	1
AMPHIPODA			
Hyalella azteca		2	1
COLEOPTERA			
Berosus	2	1	
Dubiraphia		2	
Helichus lithophilus			9
Hydroporus	2	2	
Macronychus glabratus	1		4
Scirtidae			1
Tropisternus		1	
DIPTERA			
Ablabesmyia	4	3	1
Ceratopogoninae		5	
Chironomus	3		2
Cladotanytarsus	19	1	3
Cricotopus bicinctus		4	
Cricotopus/Orthocladius		1	2
Cryptochironomus	7		1
Cryptotendipes	5		1
Dicrotendipes	10	2	41
Diptera		1	
Glyptotendipes		1	5
Labrundinia	1	10	4
Nanocladius		3	4
Paracladopelma	5		
Phaenopsectra		2	
Polypedilum convictum		1	
Polypedilum illinoense grp	3	12	1
Polypedilum scalaenum grp			3
Pseudochironomus			1
Rheotanytarsus		5	2
Simulium		2	1
Stempellina	1		
Stempellinella	13		1
Stenochironomus			4
Tanytarsus	84	49	111
Thienemanniella		3	
Thienemannimyia grp.			4

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602738], Station #3, Sample Date: 9/20/2006 11:50:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Tribelos	1		9
EPHEMEROPTERA			
Brachycercus	5		2
Caenis hilaris	42	16	18
Caenis latipennis	97	69	75
Hexagenia	6	1	
Leptophlebiidae	1	48	4
Procloeon	9	2	3
Stenacron			4
Stenonema terminatum	1	1	
Tricorythodes	3	7	
HEMIPTERA			
Ranatra nigra		1	
LIMNOPHILA			
Physella	1	11	4
ODONATA			
Argia	4	24	14
Gomphidae	1		
Gomphus	1		
Hetaerina		3	
Macromia	1		
Progomphus obscurus	1	-99	
TRICHOPTERA			
Nectopsyche	9	22	2
TUBIFICIDA			
Aulodrilus	1		
Enchytraeidae	1	1	
Limnodrilus hoffmeisteri		2	
Tubificidae		11	
VENEROIDEA			
Sphaeriidae	3	12	1

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602739], Station #4, Sample Date: 9/20/2006 1:40:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina			1
AMPHIPODA			
Hyalella azteca			6
COLEOPTERA			
Berosus		1	3
Chaetarthria			1
Dubiraphia	3		
Helichus lithophilus		2	4
Hydrophilidae	1		
Hydroporus			3
Laccophilus		1	
Scirtidae		6	12
Tropisternus	-99	2	
DIPTERA			
Ablabesmyia	10		3
Ceratopogoninae		2	
Chironomus	2		
Cladotanytarsus	21	1	1
Corynoneura	1	1	2
Cricotopus bicinctus	1	1	
Cricotopus/Orthocladius			9
Cryptochironomus	1		
Cryptotendipes	1		
Dicrotendipes	4	2	30
Forcipomyiinae			14
Glyptotendipes			1
Labrundinia	3	5	5
Nanocladius		2	2
Ormosia		1	
Paracladopelma	13		
Paralauterborniella	1		
Paratendipes	6		
Polypedilum halterale grp	3		1
Polypedilum illinoense grp	14	20	11
Procladius			1
Pseudochironomus			2
Rheotanytarsus	2	1	1
Saetheria	2		
Simuliidae	1		

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602739], Station #4, Sample Date: 9/20/2006 1:40:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Stempellina		1	
Stempellinella	13	1	
Stenochironomus			10
Stratiomys		-99	
Tabanidae			-99
Tanytarsus	63	27	60
Thienemanniella		3	
Thienemannimyia grp.		2	2
Tribelos			1
undescribed Empididae		6	
EPHEMEROPTERA			
Caenis hilaris	1		
Caenis latipennis	66	119	102
Heptageniidae	5	2	3
Hexagenia		1	
Leptophlebiidae	7	48	10
Paracloeodes	23	9	6
Procloeon	3	1	5
Stenonema terminatum	1		
Tricorythodes	9	8	6
LIMNOPHILA			
Lymnaeidae	2	2	
Physella	1	1	7
ODONATA			
Argia		19	10
Gomphus	1	-99	
Hetaerina		3	1
Macromia	2	1	
Progomphus obscurus	12	1	
TRICHOPTERA			
Nectopsyche	13	16	7
TUBIFICIDA			
Enchytraeidae			1
Tubificidae		9	
VENEROIDEA			
Sphaeriidae	3	8	

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602740], Station #5, Sample Date: 9/20/2006 3:20:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina			1
AMPHIPODA			
Hyalella azteca	1	81	9
COLEOPTERA			
Berosus	1		6
Dubiraphia	3	4	2
Helichus lithophilus		1	3
Macronychus glabratus			4
Neoporus		1	2
Peltodytes	1	1	
Scirtidae		3	
Tropisternus		-99	
DIPTERA			
Ablabesmyia	5	4	11
Anopheles		5	
Ceratopogoninae	4		1
Chironomus	7		
Cladotanytarsus	7		
Clinotanypus	1		
Corynoneura			1
Cricotopus bicinctus	1	1	
Cryptochironomus	3		
Cryptotendipes	23		1
Dicrotendipes	8	5	28
Diptera		1	
Forcipomyiinae		1	1
Labrundinia		18	1
Nilothauma			1
Parachironomus		1	
Paracladopelma			1
Paralauterborniella	3		
Polypedilum halterale grp	4		
Polypedilum illinoense grp	3	23	2
Procladius	4		
Pseudochironomus	2		3
Stempellinella	5		
Stenochironomus		1	6
Tanypus	16		
Tanytarsus	42	22	20

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602740], Station #5, Sample Date: 9/20/2006 3:20:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Thienemanniella			1
Thienemannimyia grp.		1	5
Tribelos			5
EPHEMEROPTERA			
Brachycercus	3		
Caenis latipennis	57	69	105
Heptageniidae	1	4	3
Hexagenia limbata	14		1
Isonychia rufa			1
Leptophlebiidae		6	8
Paracloeodes	1	1	
Procloeon	2	2	
Stenacron	1	4	5
Stenonema femoratum		1	8
Stenonema terminatum			1
Tricorythodes		2	2
HEMIPTERA			
Corixidae	18		1
LIMNOPHILA			
Ancylidae		1	1
Physella	5	19	19
MEGALOPTERA			
Sialis	-99		
ODONATA			
Argia		1	4
Calopteryx		1	
Enallagma		4	
Gomphus	1		1
Progomphus obscurus	-99		
RHYNCHOBDELLIDA			
Glossiphoniidae	-99		
TRICHOPTERA			
Cyrnellus fraternus			1
Helicopsyche			7
Nectopsyche	1	36	6
Oecetis	4		2
TUBIFICIDA			
Enchytraeidae	2		
Limnodrilus hoffmeisteri	1		
Tubificidae	5		

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0602740], Station #5, Sample Date: 9/20/2006 3:20:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
VENEROIDEA			
Sphaeriidae	55		7

Aquid Invertebrate Database Bench Sheet Report
East Fk Grand R [0602742], Station #1, Sample Date: 9/26/2006 12:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina		2	1
AMPHIPODA			
Hyalella azteca		1	
COLEOPTERA			
Dubiraphia	16	21	1
Helichus lithophilus		10	
Macronychus glabratus			1
DIPTERA			
Ablabesmyia	21	1	
Ceratopogoninae	5	1	
Chrysops		1	
Cladotanytarsus	11		1
Corynoneura	5	1	1
Cricotopus bicinctus			3
Cricotopus/Orthocladius	3	1	34
Cryptochironomus	5		1
Cryptotendipes	2		
Dicrotendipes	2		88
Epoicocladius	1		
Forcipomyiinae			2
Glyptotendipes	1		2
Harnischia	1		
Hydrobaenus	6		
Labrundinia	6	3	
Nanocladius	1	6	5
Nilotanypus			1
Nilothauma			1
Paratendipes	1		
Polypedilum convictum	1		1
Polypedilum halterale grp	1		
Polypedilum illinoense grp	14	1	
Polypedilum scalaenum grp			1
Procladius	6		2
Rheotanytarsus	4	14	5
Saetheria	1		
Simulium			3
Stelechomyia			1
Stempellinella	14		
Stenochironomus			23

Aquid Invertebrate Database Bench Sheet Report
East Fk Grand R [0602742], Station #1, Sample Date: 9/26/2006 12:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Tanytarsus	21	9	52
Thienemanniella	1		2
Thienemannimyia grp.		2	6
EPHEMEROPTERA			
Acentrella			7
Acerpenna		8	1
Baetis			1
Brachycercus	1		
Caenis hilaris	17	11	
Caenis latipennis	43	47	26
Fallceon		2	
Heptagenia		1	1
Heptageniidae		3	2
Hexagenia limbata	23		
Isonychia rufa		12	6
Leptophlebiidae	14	24	7
Leucrocuta			2
Paracloeodes	2		6
Procloeon	15		8
Pseudocloeon		11	
Stenacron	4	11	14
Stenonema femoratum	1	1	2
Stenonema terminatum	1	4	11
Tricorythodes	1	15	8
HEMIPTERA			
Corixidae	10		2
LIMNOPHILA			
Physella		1	1
MEGALOPTERA			
Sialis		-99	
ODONATA			
Argia		7	
Gomphus		-99	
Hetaerina		1	
Macromia		-99	
Perithemis		1	
Progomphus obscurus	1		1
TRICHOPTERA			
Cheumatopsyche		35	8
Hydroptila			3
Nectopsyche	4	56	

Aquid Invertebrate Database Bench Sheet Report
East Fk Grand R [0602742], Station #1, Sample Date: 9/26/2006 12:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polycentropodidae			1

Aquid Invertebrate Database Bench Sheet Report
West Fk Big Ck [0602743], Station #1, Sample Date: 9/26/2006 3:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina	3		1
AMPHIPODA			
Hyalella azteca		24	2
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Berosus			1
Dubiraphia	16	61	4
Helichus basalis		1	
Hydroporus		2	
Scirtidae		15	
DECAPODA			
Orconectes virilis			-99
DIPTERA			
Ablabesmyia	6	1	8
Anopheles		1	
Ceratopogoninae	4		1
Chironomus	15		1
Cladotanytarsus	18		1
Corynoneura			1
Cricotopus/Orthocladius			2
Cryptochironomus	9		
Cryptotendipes	4		
Dicrotendipes	2	1	70
Forcipomyiinae			1
Glyptotendipes	1	11	9
Harnischia	1		
Hydrobaenus	1		1
Labrundinia		13	20
Nanocladius	2	10	9
Nilothauma			1
Parachironomus		1	1
Paracladopelma	1		
Parakiefferiella			6
Paralauterborniella	2		
Paratendipes	2		
Phaenopsectra		1	
Polypedilum convictum			2
Polypedilum halterale grp	15		

Aquid Invertebrate Database Bench Sheet Report
West Fk Big Ck [0602743], Station #1, Sample Date: 9/26/2006 3:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Polypedilum illinoense grp		46	11
Polypedilum scalaenum grp	1		
Procladius	5	1	
Pseudochironomus			3
Stempellinella	16	1	3
Stenochironomus		1	18
Stictochironomus	1		
Tanytarsus	27	21	78
Thienemannimyia grp.			3
Tribelos			2
EPHEMEROPTERA			
Brachycercus	2		1
Caenis hilaris			1
Caenis latipennis	117	43	50
Hexagenia limbata	23		
Leptophlebiidae	2	19	2
Leucrocuta			1
Paracloeodes			2
Procloeon	3		4
Stenacron	1		2
Stenonema femoratum	1		1
HEMIPTERA			
Belostoma		-99	
Neoplea		4	
LIMNOPHILA			
Physella		5	1
ODONATA			
Argia		8	
Enallagma		14	
Gomphidae	1		
Ischnura	1	2	
Progomphus obscurus	-99		
TRICHOPTERA			
Cheumatopsyche	1		
Hydroptila			1
Nectopsyche		10	
Nyctiophylax			1
Oecetis	1		
Ptilostomis		2	
Triaenodes		3	
TUBIFICIDA			

Aquid Invertebrate Database Bench Sheet Report
West Fk Big Ck [0602743], Station #1, Sample Date: 9/26/2006 3:25:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Aulodrilus		1	
Enchytraeidae		1	
Tubificidae	5	2	
VENEROIDEA			
Sphaeriidae	4	-99	

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0703232], Station #2, Sample Date: 3/27/2007 2:20:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca	1	7	1
COLEOPTERA			
Dubiraphia		1	
Helichus lithophilus		6	
Neoporus	1	2	
Tropisternus		1	
DECAPODA			
Orconectes virilis	1		
DIPTERA			
Ablabesmyia		1	
Ceratopogoninae		2	
Corynoneura	1	1	
Cricotopus bicinctus	5	21	2
Cricotopus/Orthocladius	2	11	5
Dicrotendipes	1		
Hydrobaenus	1	12	1
Labrundinia		3	
Nanocladius	2	8	
Paraphaenocladius		4	2
Paratanytarsus		2	
Polypedilum convictum		2	
Polypedilum scalaenum grp		4	1
Rheocricotopus		1	
Simulium		2	11
Tanytarsus		22	4
Thienemanniella		1	
Thienemannimyia grp.		3	1
Tipula		-99	
Tribelos		2	3
EPHEMEROPTERA			
Acerpenna		2	-99
Baetisca lacustris	2	1	1
Caenis latipennis	10	125	21
Heptagenia		2	
Leptophlebia	3	20	1
Stenonema femoratum			1
Stenonema terminatum		2	1
HEMIPTERA			
Corixidae		1	

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0703232], Station #2, Sample Date: 3/27/2007 2:20:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Microvelia		2	
LIMNOPHILA			
Fossaria		2	
Physella		1	
LUMBRICULIDA			
Lumbriculidae	2		
ODONATA			
Argia		1	
Calopteryx		-99	
Gomphus		-99	
Hetaerina		1	
Macromia	1		
Progomphus obscurus	-99		
PLECOPTERA			
Perlesta		3	
TRICHOPTERA			
Nectopsyche	1	9	1
TUBIFICIDA			
Enchytraeidae	5	14	2
Limnodrilus claparedianus	1		
Limnodrilus hoffmeisteri	5	1	
Tubificidae	7	2	

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0703234], Station #3, Sample Date: 3/28/2007 8:40:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca	2	5	1
COLEOPTERA			
Helichus lithophilus		4	
Macronychus glabratus	1		
Paracymus			1
Peltodytes	1		
DIPTERA			
Ablabesmyia	3	3	
Ceratopogoninae		4	
Cricotopus bicinctus	3	15	
Cricotopus/Orthocladius		8	1
Cryptochironomus		1	
Dicrotendipes			2
Gonomyia		3	
Hydrobaenus		21	3
Labrundinia		9	
Nanocladius		6	
Nilotanypus		1	
Paratanytarsus	1	1	
Pilaria		1	
Polypedilum convictum		1	
Polypedilum illinoense grp		2	1
Simulium	2		3
Stenochironomus			3
Tanytarsus	2	24	3
Thienemannimyia grp.	1	6	1
Tribelos		1	
EPHEMEROPTERA			
Acerpenna	1		1
Baetisca lacustris		1	
Caenis latipennis	70	130	23
Hexagenia limbata	6		
Leptophlebia	2	5	1
Stenacron	1		
Stenonema femoratum			2
HEMIPTERA			
Corixidae	5		
LUMBRICULIDA			
Lumbriculidae	1		

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0703234], Station #3, Sample Date: 3/28/2007 8:40:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
ODONATA			
Argia	1	6	
Gomphus	3		
Ischnura		1	
Progomphus obscurus	4	1	
TRICHOPTERA			
Ironoquia		1	
Nectopsyche	1	11	
TUBIFICIDA			
Enchytraeidae	3	6	2
Limnodrilus hoffmeisteri		1	
Tubificidae	2		
VENEROIDEA			
Sphaeriidae		1	

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0703233], Station #4, Sample Date: 3/27/2007 4:10:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina		1	
AMPHIPODA			
Crangonyx		1	
Hyalella azteca		13	
COLEOPTERA			
Berosus		1	
Dubiraphia		1	
Helichus lithophilus		12	
Neoporus		1	
Peltodytes		2	
Scirtidae		4	
Tropisternus		1	
DIPTERA			
Ablabesmyia	1	5	1
Ceratopogoninae	5	4	
Cladotanytarsus	3		
Cricotopus bicinctus		4	8
Cricotopus/Orthocladius		3	9
Dicrotendipes			3
Diptera		1	
Ephydridae		1	
Glyptotendipes		1	1
Gonomyia			1
Hydrobaenus		9	5
Labrundinia		6	
Nanocladius		8	
Paraphaenocladius		3	
Paratanytarsus		5	2
Paratendipes	1		
Phaenopsectra		2	
Polypedilum convictum		1	
Polypedilum illinoense grp		4	1
Simulium		3	3
Stratiomys		-99	
Tanytarsus		10	8
Thienemanniella		2	
Thienemannimyia grp.		10	4
Tipulidae		1	
Zavrelimyia		1	

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0703233], Station #4, Sample Date: 3/27/2007 4:10:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
EPHEMEROPTERA			
Acerpenna		6	3
Caenis latipennis	1	101	25
Leptophlebia		15	1
Stenonema femoratum		1	5
Stenonema terminatum		1	3
HEMIPTERA			
Corixidae	8	1	
LIMNOPHILA			
Physella		1	
ODONATA			
Argia		2	3
Calopteryx		1	
Enallagma		2	
Ischnura		1	
Macromia		-99	
Progomphus obscurus	-99		
PLECOPTERA			
Perlesta		5	1
TRICHOPTERA			
Nectopsyche		7	2
TUBIFICIDA			
Enchytraeidae		11	4
Tubificidae	1		
VENEROIDEA			
Sphaeriidae	2		

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0703235], Station #5, Sample Date: 3/28/2007 10:45:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
"HYDRACARINA"			
Acarina		1	2
AMPHIPODA			
Hyalella azteca	1	59	35
COLEOPTERA			
Berosus		2	-99
Dubiraphia	1	2	
Helichus lithophilus		7	1
Neoporus		1	1
Peltodytes			2
DIPTERA			
Ablabesmyia		5	1
Ceratopogoninae		10	2
Cladotanytarsus	1		2
Cricotopus bicinctus		5	3
Cricotopus/Orthocladius	1	11	3
Cryptochironomus		1	
Dicrotendipes		4	7
Endochironomus			1
Ephydridae	1		
Glyptotendipes		1	1
Hydrobaenus	1	14	11
Labrundinia		9	
Nanocladius		4	
Nilothauma			1
Ormosia		3	
Paraphaenocladius		3	4
Paratanytarsus		19	8
Pericoma		1	
Pilaria		1	
Polypedilum convictum		1	
Polypedilum illinoense grp		7	1
Pseudorthocladius		1	
Rheotanytarsus		3	
Simulium		1	
Stenochironomus			2
Stratiomys	1		
Tabanus		1	
Tanytarsus	1	28	18
Thienemannimyia grp.		2	3

Aquid Invertebrate Database Bench Sheet Report
Muddy Ck [0703235], Station #5, Sample Date: 3/28/2007 10:45:00 AM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Tribelos		4	1
Zavrelimyia		4	1
EPHEMEROPTERA			
Acerpenna			2
Caenis latipennis	4		34
Hexagenia limbata		2	2
Leptophlebia		2	
Stenonema femoratum			2
HEMIPTERA			
Corixidae	8	1	
Microvelia		1	
LIMNOPHILA			
Fossaria		1	1
LUMBRICULIDA			
Lumbriculidae		2	
MEGALOPTERA			
Sialis		1	
ODONATA			
Argia		2	
Dromogomphus		-99	
Gomphus		-99	
Libellula			-99
Progomphus obscurus	4		
PLECOPTERA			
Perlesta		1	2
RHYNCHOBDELLIDA			
Glossiphoniidae			1
TRICHOPTERA			
Cheumatopsyche		1	
Hydroptila			1
Ironoquia		1	
Ptilostomis		1	
TUBIFICIDA			
Enchytraeidae	4	8	2
Limnodrilus hoffmeisteri	5	3	
Tubificidae	3	1	1
VENEROIDEA			
Sphaeriidae	7		

Aquid Invertebrate Database Bench Sheet Report
East Fk Grand R [0703227], Station #1, Sample Date: 3/26/2007 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
AMPHIPODA			
Hyalella azteca		2	
COLEOPTERA			
Dubiraphia	13	11	1
Helichus lithophilus		1	
Paracymus		1	
Tropisternus		1	
DIPTERA			
Ablabesmyia	1		
Ceratopogoninae	15	7	
Chaoborus	3		
Chironomus	1		
Cladotanytarsus	1		
Cricotopus bicinctus		3	5
Cricotopus/Orthocladius	6	20	98
Cryptochironomus	4		
Dicrotendipes			5
Diptera	1		1
Dolichopodidae	1		
Glyptotendipes	1		
Gonomyia			1
Hexatoma	1		
Hydrobaenus	2	7	9
Nanocladius	1	1	1
Ormosia	1		
Parakiefferiella			1
Paralauterborniella	17		
Paraphaenocladius		1	1
Paratanytarsus		1	
Phaenopsectra	1		
Polypedilum convictum		2	6
Polypedilum halterale grp	4		
Polypedilum illinoense grp	2		
Polypedilum scalaenum grp	1		
Procladius	2		
Pseudosmittia			2
Rheotanytarsus	1	4	
Simulium		22	31
Stictochironomus	2		
Tanytarsus	2	2	1

Aquid Invertebrate Database Bench Sheet Report
East Fk Grand R [0703227], Station #1, Sample Date: 3/26/2007 1:00:00 PM
NF = Nonflow; RM = Rootmat; SG = Woody Debris; -99 = Presence

ORDER: TAXA	NF	RM	SG
Thienemanniella		3	1
Thienemannimyia grp.		12	1
Zavrelimyia		9	
EPHEMEROPTERA			
Acerpenna		12	8
Baetisca lacustris	1		1
Caenis latipennis	83	3	54
Heptagenia	1	10	26
Hexagenia limbata	8		
Leptophlebia	1	41	4
Stenacron	2	20	8
Stenonema terminatum	2		4
HEMIPTERA			
Corixidae	10		
Trepobates		1	
ODONATA			
Argia		1	
Enallagma	1		
Gomphus	-99		
Progomphus obscurus	1		
PLECOPTERA			
Perlesta	1	9	4
RHYNCHOBDELLIDA			
Piscicolidae	1	1	
TRICHOPTERA			
Cheumatopsyche	1	1	
Nectopsyche		3	1
TUBIFICIDA			
Enchytraeidae	13	16	3
Limnodrilus hoffmeisteri	1		
Tubificidae	10	11	